DOCUMENT RESUME

ED 193 839 EC 130 191

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TITLE The Behavior Observation Scale for Autism (BOS): IQ and the Behavior of Autistic Children.
PUB DATE May 80
NOTE 21p.: Paper presented at the Western Psychological Association (Honolulu, HI, May, 1980).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Autism: *Behavior Patterns: Behavior Rating Scales: *Handicap Identification: *Intelligence: Mental Retardation: Preschool Children

ABSTRACT

The study compared the behavior of 61 preschool autistic children with that of 35 retarded children matched for mental age and 30 normal children matched for chronological age. Ss were rated on a 67 item Behavior Observation Scale during three free play sessions. Among findings were that six behaviors (grimace/gesticulation, echolalic speech, object sniffing, eye contact, the use of objects to generate stimuli, and object spinning) distinguished the high IQ (over 70 on performance IQ test) autistic group from the normal group, and that six behaviors (eye contact, repetitive jumping, leading adult by hand, echolalic speech, hand sniffing, and motility of response to stmulus) differentiated the low IQ autistic group from the retarded group. It was concluded that it is possible to discriminate among the study groups by objectively coding their behaviors. (PHR)

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The Behavior Observation Scale for Autism (BOS): IQ and the Behavior of Autistic Children[1]

Abbreviated title:

Behavior Observation Scale for Autism

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Paper presented Western Psychological Association, Honolulu, 1980

Not for Citation

EC130191

INTRODUCTION

In spite of the vast research that has been conducted over the last thirty years on the syndrome of autism, there has not yet been established an objective method for quantifying specific pathognomonic behaviors. Several methodological problems have limited the development of an objective diagnostic system. First, is the necessity of utilizing appropriate comparison groups to account for the overlap among behaviors exhibited by children with the syndromes of autism and mental retardation as well as normals (cf., Freeman, Ritvo, Guthrie, Schroth and Ball, 1979; Freeman, Guthrie, Ritvo, Schroth, Glass and Frankel, 1979). Second, since the syndrome of autism is defined by a heterogeneous set of symptoms, a scale must be based on many behaviors rated simultaneously and from large numbers of children (Ornitz and Ritvo, 1976). Such heterogeneity of symptoms complicates the development of a direct observational scale since subgroups of autistic children may show different sets of behaviors. For example, Bartak and Rutter (1976) reported that autistic children with testable IQ's above 70 showed a different patterning of symptoms than those with testable IQ's below 70. The purpose of this study was to extend the findings of Bartak and Rutter (1976) by comparing the behavior of autistic children to that of normal and mentally retarded children.

METHODS

Subjects

The subjects for this study were: (1) 61 children initially screened who meet the National Society for Autistic Children's (1978) and DSM III diagnostic criteria for the syndrome of autism; (2) 35 children with a diagnosis of mental retardation matched to the autistic group on mental age obtained on the Merrill-Palmer Preschool Performance Test (Stutsman, 1931); and (3) 30 normal children matched to the other two groups by chronological age.

mentally retarded groups on chronological age, but not on mental age and IQ.

Insert Table 1 & 2 about here

Procedures

The Behavior Observation Scale (BOS) contains 67 objectively defined behaviors which are listed in Table 3. Each child was observed through a

Insert Table 3 about here

one-way mirror in a playroom setting. The playroom contained a child's table and chair, two toy boxes, and one adult chair.

Each child was brought into the room by the examiner who told the child to do anything he or she wants. If the child was crying initially the observation period did not begin until the child was quiet. An observation period consisted of recording the occurrence or absence of the 67 behaviors as defined on the BOS during nine, three-minute intervals. Each behavior was coded as follows: "0" if it did not occur, "1" if it occurred once, "2" if it occurred twice, and "3" if the child engaged in the behavior more or less continuously throughout the entire three minute interval. In addition, responses to standardized stimuli (e.g., spinning top, burglar alarm, intermittent flashing light, a texture ball, tuning fork, and the examiner) were recorded during the first ten seconds of seven of the nine intervals. Each session began and ended with a three-minute baseline observation period. During the procedure the examiner in the playroom presented the various stimuli without comment. During one of the three minute intervals the examiner actively interacted with the child by attempting to engage in ball play. At all other times, the examiner was

Table 1

Chronological Age Distribution of Subjects

	Autistic	MR	Normal	Total
≥ 23	0	0	0	0
24-29	1	1	2	4
30-35	3	3	7	13
36-41	14	5	4	23
42-47	8	6	11	25
48-53	11	7	6	24
54-59	4	6	2	12
60-65	4	1	4	9
< 65	14	11	5	30
TOTAL	59	40	41*	140

*MA and IQ not available on 1 subject.

Table 2

A. Distribution of Mental Age Score

Obtained on Merrill-Palmer Pre-School Performance Test

	Autistic	MR	Normal	Total
≥ 23	16	12	0	28
24-29	11	9	1	21
30-35	12	5	1	18
36-41	4	3	3	10
42-47	3	4	4	11
48-53	4	1	5	10
54-49	5	3	5	13
50-65	0	2	1	3
< 65	4	1	20	25
TOTAL	59	40	40	139

B. Distribution of IQ Scores

Obtained on Merrill-Palmer Pre-School Performance Test

	Autistic	MR	Normal	Total
≥ 30	8	5	0	13
31-40	3	5	0	8
41-50	6	4	0	10
51-60	13	4	0	17
61-70	8	11	0	19
71-80	7	9	0	16

Table 2 (cont'd)

	Autistic	MR	ormal	Total
81-90	6	1	0	7
91-100	2	1	3	6
101-110	3	0	5	8
111-120	2	0	6	8
121-130	1	0	8	9
131-140	0	0	6	6
141-150	0	0	5	5
151-160	0	0	5	5
< 160	0	0	2	2
TOTAL	59	40	40	139

Table 3

BOS Behaviors

General Behaviors (Each item scored 0-3)

Repeats Sounds (Attends to self-induced sounds)
Ear Banging
Tooth Grinding
Regards Hands (Looks at Hands)
Staring
Visual Detail Scrutiny
Rubbing Surfaces
Mouths Objects
Repetitive Banging
Mouths Hands
Sniffs Objects
Sniffs Hands
Spins Top
Hand-flapping
Finger-flicking
Gesticulation/Grimacing
Whirling
Toe Walking
Darting/Lunging
Posturing
Body Rocking
Repetitive Jumping
Head Banging
Finger Wiggling
Nuchal Hyperextension

Insists on Being Held
*Eye Contact
Attends to One Part of Adult
Social Smile
Uses Others as Extension of Self (Leads Adult by the Hand)
Infantile Clinging
*Ignores Examiner
*Toys Used Functionally
Inspection of Objects
*Manipulation of Objects
Purposeful Toy Play
*Constructive Toy Play
Inappropriate Contact Attempt
*Remains Preoccupied
Orders and Arranges Objects
*Ritualistic Use of Objects
Uses Object to Generate Stimuli
Ignores Objects
Undifferentiated Holding of Objects
Lets Object Passively Fall from Hand
Spins Object
Uses Part of Body to Generate Stimuli
Turns Flashlight On/Off
Turns Gong On/Off

Table 3 (cont'd)

BOS Behaviors

Language (Each item scored 0 or 1):

Mute

Babbles

Cries

Communicative Speech

Immediate Echolalia

Delayed Echolalia

Negative Echolalia

Response to Stimuli (Each item scored 0 or 1):

Delayed

Staring at Stimulus

Anticipatory Response to Gesture

Response to Command for Eye Contact

Attending Response (One item, scored 0-6):

None

Minimal

Mild

Moderate

Severe

Very Severe

Panic

Response to Being Held (One item, scored 0-2):

Resists

Tolerates

Accepts

Response to Ball Play (One item, scored 0-3):

Ignores

Minimal

Active

Deviant

Inappropriate Response to Pain (scored 0-1)

Motility Disturbance to Stimuli (scored 0-1)

passive, sat in a corner and did not respond if the child initiated contact.

Each child was observed on three days, approximately one week apart. All behaviors were scored by two observers (the examiner in the room and another viewing via a one-way mirror) and exact agreement (i.e., number of agreements/ number of agreements plus disagreements) or interobserver reliability were obtained ($r = > .80$ on all but the seven behaviors indicated by an asterisk in Table 3).

Two primary data bases were established for the discriminant analysis. The first consisted of the means between observers for nine intervals of the first three observation periods of each child. The statistical units of observation for a child were fifty-eight behavioral variables, each of which were the means of fifty-four raw scores. For the second data base the three weekly observation sessions were treated as independent observations. This was done so that behaviors which tended to recur in children from week to week could be identified. Thus each child was represented by three statistically separate observations, each of which were the mean scores between observers and nine intervals based upon a total of eighteen raw scores.

Both data bases were analyzed in two ways: as they had been defined (an approximation to the rate of occurrence) and as to agreement between observers (as to whether the behavior had occurred or not).

To assess possible developmental effects on many of these behaviors subjects were divided into two age cohorts (the younger children ages two and three, and the older children ages four and five--see Table 4). For subsequent analysis the autistic groups were further divided into those with Performance IQ's above 70 (High IQ group) and below 70 (Low IQ group).

Insert Table 4 about here

Table 4

Number of Subjects in Discriminant Analysis

A. Age Distribution of Subjects

	Younger Group			Older Group		
Age (In Years)	2	3	Total	4	5	Total
Autistic	3	22	25	14	7	21
Retarded	4	10	14	13	4	17
Normal	9	15	24	18	8	16
			63			54

B. IQ Distribution of Subjects

	IQ > 70	IQ ≤ 70	Total
Autistic	16	30	46
Retarded	0	26	26
Normal	39	0	39
	55	56	111

Since Performance IQ was important in classifying all the age groups and since the autistic overlapped with both the normals and retardates, the autistics were divided into a High IQ group (Performance IQ > 70) and a Low IQ group (Performance IQ < 70). In the following discriminant analysis the High IQ autistics were compared to the normal control group and the Low IQ autistics to the retarded group. The results of these analyses are presented in Table 5. Six behaviors defined the discriminant function for the High IQ versus normal group comparison and yielded a 96.4% correct overall classification (Echolalic Speech; Sniffs Objects; Eye Contact; Uses Objects to Generate Stimuli; and Spins Objects). Only two of the 16 autistic children were misclassified as normal.

Insert Table 5 about here

Six behaviors defined the discriminant function for the Low IQ versus retarded group comparison (Eye Contact; Repetitive Jumping; Leads Adult By Hand; Echolalic Speech; Sniffs Hands; and Motility Response to Stimulus). This yielded an 80.4% correct overall classification (83.3% and 76.9% correct classifications for the autistic and retarded groups respectively).

4. The Diagnostic Importance of Individual Behaviors

The behaviors which defined the discriminant functions in each of the analyses are grouped and listed in Table 6. However, the diagnostic importance

Insert Table 6 about here

of any individual behavior must be interpreted with caution and its clinical significance viewed in light of the number of subjects in a group as well as the frequency of occurrence of the behavior.[10] When the 2-4 year olds are compared to the 4-6 year olds, only three behaviors occur in both groups

Table 5

Results of Discriminant Analysis

A. High IQ Autistic Group (IQ > 70)

Diagnostic Group	% Correct	Number Classified In Each Group		
		Autism	Normal	Total
Autism	87.5%	14	2	16
Normal	100.0%	0	39	39
Total	96.4%	14	41	55

Behaviors: Grimace/Gesticulation; Echolalic Speech; Sniffs Objects; Eye Contact; Uses Objects to Generate Stimuli; Spins Objects

Table 5 (continued)

Results of Discriminant Analysis

B. Low IQ Autistic Group (IQ $\leq$ 70)

Diagnostic Group	% Correct	Number Classified In Each Group		
		Autism	Retarded	Total
Autism	83.3%	25	5	30
Retarded	76.9%	6	20	26
Total	80.4%	31	25	56

Behaviors: Eye Contact; Repetitive Jumping; Uses Others as Extension of Self; Echolalic Speech; Sniffs Hands; Motility Response to Stimulus

Table 6

Comparison of Results of Discriminant Analyses

	2-4 Year Olds	4-6 Year Olds	2 Year Olds	3 Year Olds	4 Year Olds	5 Year Olds
Solitary Behaviors	Handflapping Finger Wiggling Covers Ears Repetitive Jumping	Handflapping Grimace/ Gesticulation Repetitive Jumping Whirling Repeats Sounds	Posturing Toe Walking	Handflapping Regards Hands	Posturing	Covers Ears Repetitive Jumping Head Banging
Relation to Objects	Uses Objects to Generate Stimuli Finger Flicking	Rubs Surfaces	Finger Flicking --	Visual Detail Scrutiny	--	
Relation to People	Eye Contact Social Smile Ignores Examiner	Deviant Ball Play Appropriate Ball Play	--	--	Eye Contact Deviant Ball Play	Deviant Ball Play Clinging
Language	--	--	--	--	--	--
Response to Stimuli		Deviant Ball Play Appropriate Ball Play	Stares at Stimulus	Appropriate Attending Response	Deviant Ball Play	Deviant Ball Play
Other	Performance IQ	Performance IQ	Performance IQ	Performance IQ	Performance IQ	Performance IQ

Table 6 (Continued)

Comparison of Results of Discriminant Analyses

IQ ≤ 70	IQ > 70
Repetitive Jumping	Grimace/Gesticulation
Sniffs Hands	
--	Sniffs Objects
	Uses Objects to Generate Stimuli
	Spins Objects
Eye Contact	Eye Contact
Leads Adult by Hand	
Echolalic Speech	Echolalic Speech
--	--
Motility Response to Stimulus	--

(Handflapping; Repetitive Jumping; and Performance IQ). However, while both groups are best described by a combination of Solitary and Relating to People behaviors, the specific behaviors are different for the two groups.

When the age groups are examined separately Solitary and Response to Stimuli variables best describe both the 2 and 3 year old autistic groups. On the other hand, there is more overlap between the 4 and 5 year old group and the 4-6 year olds. Both are best described by Solitary and Relating to People variables and there is overlap among the individual behaviors (e.g., Deviant Ball Play and Repetitive Jumping).

When the groups were divided by IQ, the Low IQ group was best described by Solitary and Relating to People Behaviors while the High IQ group was best described by Relating to Objects and Relating to People behaviors. For both groups, Eye Contact and Echolalic Speech were important, indicating that these two behaviors may be of particular significance.

Discussion

The results from this study indicate that it is possible to discriminate amongst groups of autistic, retarded and normal children by objectively coding their behaviors. Furthermore, it is possible to statistically discriminate within the groups by considering both the ages and developmental levels of the children. These results support and extend our earlier findings[2] and those of Bartak and Rutter[5] which indicated that developmental perspectives must be applied to the complex problem of objective diagnosis of the syndrome of autism.

The current findings also have implications for the interpretation

of ours' and other investigators' prior research results. It appears that at least some of the variability reported in both clinical and biological studies of autism might be accounted for by the failure to utilize comparison groups which reflect both the age and developmental level of the autistic children studied.

Acknowledgements

This research was supported in part by MH 29248 awarded to B. J. Freeman, Ph.D.; by MH 30897 awarded to Peter Tanguay, M.D., for Clinical Research Center for the Study of Childhood Psychosis; by Maternal and Child Health Project No. 927 awarded to James Q. Simmons, III, M.D., Chief of Child Psychiatry; by MH 31274 awarded to Edward R. Ritvo, M.D., for Genetic and Immuno-hematologic Factors in Autism, all of the Division of Mental Retardation and Child Psychiatry, University of California, Los Angeles, California; and by the Solomon and Rebecca Baker Foundation. Computing was done at Health Sciences Computing Facility, University of California, Los Angeles.

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An Informed Consent Form approved by the UCLA Medical School Human Subject Protection Committee was obtained after the nature of the procedures had been fully explained.

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